OTS: 60-41,382

JPRS: 5571

16 September 1960

5571

THE ACTION OF CERTAIN PHYSIOLOGICAL FACTORS ON THE VECTOR ELECTROCARDIOGRAM

By V. N. Tsvetskovskiy

- USSR -

Distributed by:

OFFICE OF TECHNICAL SERVICES
U. S. DEPARTMENT OF COMMERCE
WASHINGTON 25, D. C.

U. S. JOINT PUBLICATIONS RESEARCH SERVICE
205 EAST 42nd STREET, SUITE 300
NEW YORK 17, N. Y.

JPRS: 5571

CSO: 4595-N

THE ACTION OF CERTAIN PHYSIOLOGICAL FACTORS ON THE VECTOR ELECTROCARDIOGRAM

[Following if the translatinn of an article by V. N. Tsvetskovskiy entitled O Vozdeystvii Nekotorykh Fiziologicheskikh Faktorov na Vektorelektrokardiogrammu (English version above) in Klinicheskaya Meditsina (Clinical Medicine), Vol. XLI, No. 6, Moscow, 1960, pages 41-44.]

We, as well as other authors (E.A.Kyandzhuntseva and V.I. Makolkin), have given attention to the considerable variability in the vectorcardiogram, as compared with the electrocardiogram and even with the ballistocardiogram, in the same subjects. We have been unable to detect changes in the state of the cardiovascular system by ordinary clinical tests and observations, however, which has complicated the problem of analysis.

We studied 56 healthy young men 20 years of age. After the usual clinical studies and roentgenoscopy of the chest, we made parallel recordings of the standard electrocardiogram with the "Simens" electrocardiograph (in some cases on the vectorcardioscope) with a sensitivity of the apparatus of one mv = one cm, and of vectorcardiograms with five chest projections (by the method of I.T.Akulinichev) in the band of frequencies of zero to 125 c/s

initially in the supine position, breathing spontaneously after a preliminary ten-minute rest, and then upon holding the breath at the height of inspiration, at the height of expiration, positioned on the left side, then on the right, and in the sitting position after 20 deep knee bends in 30 seconds. The studies were carried out at the same time, three hours after breakfast.

In our analysis of the vectorcardiograms we gave special attention to the direction of the QRS loop, to changes in its form, dimensions, and orientation, and also to changes in the position of the T loop with respect to the QRS loop, as projected on the screen of the vectorcardioscope without construction of a spatial figure.

The original electrocardiograms and vectorcardiograms, recorded in the supine position with the subjects breathing spontaneously, corresponded in all respects to the normal as described in the literature (A.I.Fogel'son, I.T.Akulinichev, M.I.Kechker, Sh.I.Shurgaya, E.A.Kyandzhuntseva and V.I.Makolkin, Z.Z.Dorofeyeva and I.F.Ignat'yeva). With transition to the sitting position the vectorcardiogram changed in shape and dimensions in 48 subjects, of which in 19 the QRS loop increased proportionately in all directions, principally in projections I and IV; less frequently it only widened, forming a circle instead of a leaf or a figure of eight; in isolated cases it was reduced in projections II and III. In all of these instances, there were no changes in the electrocardiogram.

In 29 subjects the vectorcardiogram changed primarily by means of an increase in and displacement from the isoelectric point of the final segment of the QRS loop, which corresponds to the S wave of the electrocardiogram (the vector of the base), with simultaneous diminution in the length of the axis of the loop (vector of the apex). These changes were most frequently seen in projections IV, V, and I, and indicated a shift in the electrical axis of the heart to the right, which was most pronounced in persons of asthenic habitus.

Evidence of displacement of the electrical axis of the heart to the right on the electrocardiogram (reduction of R_I, increase of R_{III}, appearance of S_I) was noted in 21 of 29 men; in the remaining eight subjects neither the vectorcardiogram nor the electrocardiogram showed changes.

The orientation of the QRS loop changed in 20 men, of whom in four a shift in the maximum vector was noted in projections I, III, IV, and V; in five in projections III, IV, and V; in three in projections III and IV; and in eight, only in projection V. The most sensitive was projection V, which records potentials from the base of the heart. In this projection, displacement of the maximum vector was seen in 16 cases, of which in 12 the shift was clockwise from the fifth or sixth sector to the sixth, seventh, or eighth sector (apical semicircle) and in four cases it was counterclockwise to the fourth or third sector (inferior semicircle). In projection II, changes in the or-

ientation of the QRS loop did not occur. The direction of the QRS loop did not change in all projections.

Hence, displacement of the heart to the right upon shifting to the vertical position was reflected considerably more often in the vectorcardiogram than in the electrocardiogram.

In the left decubitus position, there was an increase in the final portion of the QRS loop in 20 cases in different projections and in different combinations of projections, but this occurred most often in projection IV, slightly less often in projections I and V. In this, some of the recordings showed a simultaneous slight reduction in the long axis of the loop. Of these 20, only in eleven did the electrocardiogram show some signs of change (reduction in R_I, increase in R_{III}, appearance of S_I).

In the remaining 36 cases the electrocardiogram did not change, while in the vectorcardiogram of 18 subjects there was lengthening(elongation) of the QRS loop in all projections; in four subjects, the loop was widened in projection III and constricted in projection II. In the other 14 cases, the electrocardiogram in the left decubitus position showed no changes. Changes in the orientation of the QRS loop and in the direction of the trace were not observed in this position.

In the right decubitus position, in 23 subjects the vectorcardiogram showed increases in the length and width of the QRS loop, especially in the first middle, transitional, and second middle portions, primarily in projections IV, I and V.

These changes in the vectorcardiogram in 12 cases were associated with an increase in R_I, and appearance or increase of S_{III} on the electrocardiogram. Increase in the initial or final parts of the QRS loop were not seen with subjects in the right decubitus position.

In the other 35 cases, no changes occurred in the vector- or electrocardiograms.

In projection II, which records potentials primarily from the left ventricle, the QRS loop also showed no substantial changes. Changes in the orientation of the QRS loop were observed in eight subjects: in four cases in projections III, IV, and V, and in four others in projection V only. In all of these cases the maximum vector was displaced in the clockwise direction: in projection III within the limits of sectors two to five, in projection IV from the sixth to the first sector, and in projection V from the fifth or sixth to the sixth, seventh, or eighth sectors. Changes in the orientation of the QRS loop were accompanied in only four cases by changes in the electrocardiogram characteristic of changes in the electrical axis of the heart to the left. No changes were seen in the direction of the trace.

With breath holding at the height of inspiration, the form and dimensions of the QRS loop changed in 52 subjects. In this, the QRS loop was reduced in the majority of cases; it was compressed, as it were, chiefly through reduction in the maximum vector or in all directions,   in all projections or at

least in the majority of them. In 22 cases, moreover, there was a certain increase in the final portion of the QRS loop, especially in projections III, V, and I.

Changes in the orientation of the QRS loop were noted in 20 subjects, in four of whom these changes were seen in projections I, III, IV, and V; in four in projections I, III, and V; in three only in projection IV, and in nine only in projection V. In this the maximum vector of the loop was displaced clockwise by 40 to 90 degrees.

The most sensitive was projection V, in which displacement occurred in 19 cases. Only in projection I was the displacement in the maximum vector in four cases counter-clockwise, as far as +10 to +30 degrees. The direction of the loop did not change.

Displacement of the electrical axis to the right at the height of inspection was seen in the electrocardiogram in 31 subjects. After deep inspection, expiration restored the original vectorcardiogram: the QRS loop again increased; there was "fusion" primarily through increase in the maximum vector; and the original size of the vector of the base was restored.

In isolated instances in which, upon inspiration, there was not a reduction but a uniform increase in the QRS loop in projections IV and V, deep expiration caused a reduction ("compression") of the loop. The original orientation of the maximum vector of the QRS loop was also restored.

After 20 deep knee bends in 30 seconds, in 15 cases the form, and dimensions of the QRS loop of the vectorcardiogram and electrocardiogram showed no changes. In 28 subjects there was a lengthening of the T loop and an increase in the maximum vector of the QRS either in all or in different combinations of several of the projections: the QRS loops in all cases were elongated, and sometimes markedly constricted. These changes were accompanied only in 12 persons by a general increase in the waves of the QRS complex of the electrocardiogram.

In 13 subjects there was a moderate, uniform reduction in the QRS loop, usually in projection II (primarily compression), with parallel widening of it, primarily in projection III. In eight of the 13 cases there was a slight reduction in R_I and an increase in R_{III} in the electrocardiogram.

The maximum QRS vector in projection V was displaced clockwise within limits of 30 to 90 degrees in seven subjects. Changes were not observed in the direction of the QRS loop following physical exercise.

As concerns the inter-relationships of the QRS and T loops, the latter, as a rule, remained directed concordantly under all conditions, being situated within the QRS loop, and only in isolated cases, with marked compression and considerable elongation of the QRS loop, was the T loop situated outside the limits of the QRS loop, while remaining parallel with it.

Conclusions

(1) Displacement of the heart (with changes in the position of the body and with respiration) and physical exercise in healthy people do not influence the direction of the QRS loop of the vectorcardiogram or the mutual disposition of the loops (QRS and T), and do not cause marked deformations of the trace. These features of the vectorcardiogram are stable with respect to the above-mentioned physiologic influences.

(2) The form, dimensions, and, to a lesser degree, the orientation of the QRS loop of the precordial vectorcardiogram, especially in projections V, IV, and I, are unstable and variable features of the vectorcardiogram.

(3) Upon shifting to a vertical position, or to the left decubitus position, in some cases there was an increase in the final part of the QRS loop (the vector of the base) with simultaneous reduction in the maximum vector; in other cases the QRS loop increased proportionately in all directions or was considerably elongated in all or in a majority of projections.

(4) The vectorcardiogram changed frequently and markedly in connection with the phases of respiration. Deep inspiration, as a rule, caused a pronounced reduction in the QRS loop, especially of the maximum vector; in some cases there were changes in the orientation of the QRS loop (displacement in a clockwise direction primarily in projection V, and, to a lesser extent, in projections I, III, and IV). Expiration restored the original vec-

torcardiogram.

(5) After physical exercise, there was in some cases an increase in the maximum QRS vector and an elongation of the T loop in all or in different combinations of the majority of projections; in other cases there was a uniform reduction in the QRS loop in projection II with simultaneous broadening of it in projection III.

(6) To changes in the position of the heart in the chest and to physical stress, the vectorcardiogram reacts with much more sensitivity than the electrocardiogram, since the vectorcardiogram reflects more fully the electrical activity of the heart.

Bibliography

Akulinichev, I.T., "Klin. Med." [Clinical Medicine], 1951, No.8, 44

Dorofeyeva, Z.Z., Ignat'yeva, I.F., "Ter. Arkh." [Therapeutic Archives], 1958, No.3, 55

Kyandzhuntseva, E.A., Makolkin, V.I., "Ter. Arkh.", 1958, No.3, 39

Kechker, M.I., Shurkaya, Sh.I., "Klin. Med.", 1958, No.8, 87

1658 END